NDEVC News

NONDESTRUCTIVE EVALUATION VALIDATION CENTER

U.S. DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION

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Procedure for the UT of Pins Nearing Completion

Following the collapse of the Mianus River Bridge in June 1983, there has been an increased interest in the condition evaluation of bridge pins. Ultrasonic Testing (UT) has been used by many States to determine if pins have internal defects that cannot be observed by visual inspections. Most States, however, do not have enough pins within their bridge inventory to warrant a dedicated pin inspection team, and may have limited experience with UT of pins. Many States rely on contract services to perform the inspections. Reacting to requests by several States, the NDEVC has recently completed a report designed to assist States with the inspection of pins. The report includes procedures and practices for UT of pins, as well as background information such as the basics of wave theory, UT instruments and their limitations, the type of results that should be expected from UT and how to interpret results.

The report documents a study that investigated the practice and application of UT for the detection of defects in bridge pins. This study consisted of two basic areas of work.

First, information on wave theory, general UT requirements and procedures, specific pin inspection-related issues, and other germane information was collected and summarized in language familiar to civil engineers. Some of these topics include cleaning requirements, scanning patterns, use of angle beam transducers, sizing techniques, and interpretation of signals. Also included is a thorough description of the types and general format of documentation recommended for pin inspections and a discussion of inspector qualifications and certifications.

Second, a series of laboratory trials were conducted. Testing was completed to confirm and demonstrate distance amplitude correction, angle beam and straight beam sensitivity to cracks, defect sizing, acoustic coupling, and beam diffraction. Although there are a number of different aspects of the experimental program that will prove useful, of principal note is the work that was completed to investigate the presence of acoustic coupling during pin inspections. Acoustic coupling is a phenomenon that occurs when ultrasonic waves pass from the pin to either the girder web or hanger plate and result in irrelevant indications. The figure (on page 4) shows a setup that was used to study this phenomenon with a screen shot showing the resulting ultrasonic signal. With this test setup, the ultrasonic signal passes from the transmitting transducer, through the pin and into the test fixture (representing the web and hanger plates) where it is detected by a receiving transducer. This testing clearly indicates the presence of the acoustic coupling phenomena simply because a UT signal is detected on the test fixture when it was transmitted into the pin.

The final product of this study is a document for transportation organizations that are either performing pin inspections themselves or are contracting for these services. The report documents what

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Inside this issue:

Survey of Inspection Practices for Light Poles and Sign Structures

State transportation agencies were recently surveyed about their inspection practices for light poles and overhead signs and signal support structures. In several documented instances, these structures have failed and fallen into traffic below. Naturally, these incidents have increased interest in the inspection methods used on these ancillary highway structures.

The survey dealt with four main topic areas: inventory-type information, inspection procedures, problems encountered, and solicitations for improvements in the inspection process.

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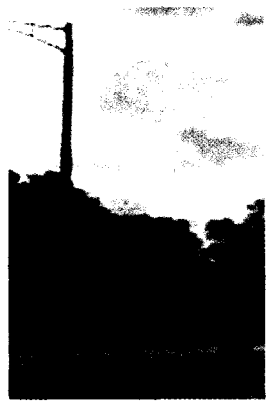

Remote Light Pole Inspection

NDEVC NEWS is the newsletter of the Federal Highway Administration's Nondestructive Evaluation Validation Center.

The NDE Validation Center was established by the Federal Highway Administration in 1998. The objective of the NDEVC is to improve the state of the practice for highway bridge inspection. The Center a resource for State transportation agencies, industry, and academia involved in the development and testing of innovative NDE technologies. The NDEVC provides State highway agencies with independent evaluation and validation of NDE technologies, develops new NDE technologies, and provides technical assistance to States exploring the use of these advanced technologies.

The NDE Validation Center uses a series of unique resources to assess the factors affecting the reliability and performance of NDE systems. The Validation Center is located at the Turner-Fairbank Highway Research Center in McLean, VA. To supplement the capabilities of these laboratory facilities, a series of bridges located in northern Virginia and southern Pennsylvania are used to conduct field investigations. In addition, a collection of component test specimens are used in various test programs.

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NDEVC News Updates

HERMES II Project Progress

A technical panel meeting for the HERMES II project was convened at Lawrence Livermore National Laboratory (LLNL) on June 12, 2001, to update the participating pooled fund participants on the project progress. This ongoing project has an overall objective to develop an instrument that can detect corrosion-induced concrete delaminations in bridge decks. Current project development status was outlined, and components under development at LLNL were demonstrated. Initial testing of the HERMES II antenna, under controlled laboratory conditions, indicates significantly improved performance compared to the original HERMES antenna. Preliminary performance tests in California and definitive performance tests in Virginia are planned in the coming months to further study antenna performance. These tests will determine the delamination-detection capabilities of the new system. For further information, contact:

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Automated UT of Butt Welds

As was reported in the last issue of *NDEVC News*, the NDEVC conducted a proof-of-concept study related to the application of automated UT systems to the inspection of girder butt welds. As a result of this study, a parallel testing study is currently being planned that will compare the accuracy and reliability of automated UT systems to conventional radiography and manual UT techniques. To conduct this study, the NDEVC recently purchased an automated UT system from the Force Institute in Denmark. Among other attributes, this system provides three-dimensional visualization of UT results and permits the permanent storage of test results. For further information, contact:

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SMT Conference

Plans are underway for the fifth semi-annual Structural Materials Technology (SMT) Conference. The conference is being co-sponsored by Federal Highway Administration (FHWA), New York State Department of Transportation (NYSDOT), American Society Civil Engineers (ASCE), and Transportation Research Board (TRB). The American Society for Nondestructive Testing (ASNT) is providing services to help organize the conference, which will be held September 10–13, 2002, in Cincinnati, OH.

The conference will promote the exchange of information between researchers, practitioners and infrastructure owners on the application of NDE technologies for the condition assessment of highway bridges. In an informal conference setting, participants, and presenters will discuss innovative new NDE technologies. Additionally, they will discuss best practices for applying existing technologies, and the problems and significant challenges faced by owners trying to assess the Nation's infrastructure. A call for papers is available at www.asnt.org.

For further information, contact the conference chairs:

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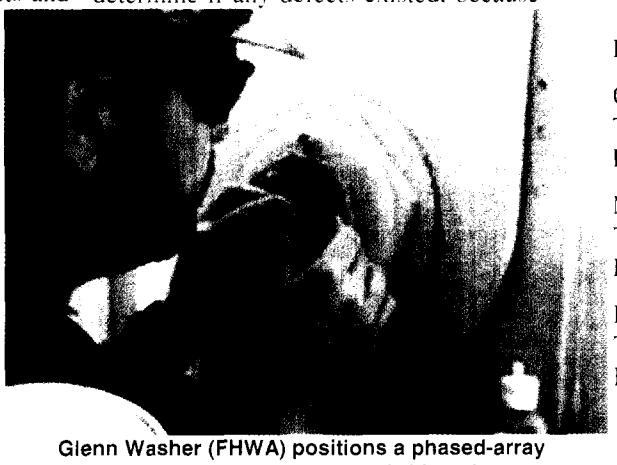
Phased-Array Ultrasonic Technique Used to Inspect Bridge Pins

Bridge pin inspection techniques have been the focus of research work at the NDEVC for a number of years. Because bridge pins can often be part of a fracture-critical structure, techniques are needed that can easily and reliably detect defects. Recently, the NDEVC, along with FHWA Eastern Federal Lands Highway Division (EFLHD) and Edison Welding Institute (EWI), tested a new phased-array ultrasonic technique that has the potential to make pin inspections easier and more reliable and to provide more information about defects within the pin.

Pin inspections are typically (see cover story) performed with ultrasonic systems. With conventional ultrasonic techniques, it is often difficult to identify defects and separate these defects from other effects such as wear grooves. Much training and skill is needed by the operator to correctly intrepret the signals obtained with this method. Because of this limita-tion, the NDEVC is exploring more advanced ultrasonic methods to inspect bridge pins. Phased-array ultrasonic techniques have been used successfully in the medical field for a number of years. Only recently has equipment for industrial applications been available for practial use. Phased-array ultrasonic methods can more easily scan a complex object, such as a bridge pin, and provide a clear image of features within that object.

To assess the effectiveness of this method, phased-array ultrasonic instrumentation was tested in Rocky Mountain National Park, CO, on a bridge in the inventory of structures inspected by the EFLHD. This structure is a three-span steel bridge with each span joined by a pin and hanger assembly. The bridge was built in 1960, and with the exception of visual inspection, no prior examination of the pins, had been conducted. John Thiel, EFLHD Bridge Inspection Program Coordinator, requested an examination of the pin connections to determine if any defects existed, because the structure has only two girders and is fracture-critical.



Glenn Washer (FHWA) positions a phased-array ultrasonic transducer on a bridge pin

The pins on this bridge were first inspected using conventional ultrasonic equipment and techniques, and a few crack indications were observed in each of the pins. These crack indications were most likely due to wear grooves or some other non-crack feature. Phased-array ultrasonic instrumentation was then used on the pins.

The phased-array instrumentation worked well for testing the pins and provided the ability to more easily identify non-crack features, such as wear grooves. Based on this preliminary testing, it appears this method has the potential to be effectively applied to bridge pin inspection.

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Survey of Inspection Practices for Light Poles and Sign Structures

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Responses have been received from 37 transportation agencies.

The results indicate that inspection philosophies vary greatly from State to State and that the number of respondents that conduct some level of inspection and the number that maintain inventories of structures is roughly the same.

About three-quarters of transportation agencies inventory their overhead sign support structures and their high-mast light poles, but only about one-third inventory their traffic signal supports and their regular-height light poles. So when inspections are performed, they are most likely performed on the sign support structures and high-mast light poles. For example, 76 percent of respondents indicated that they inventoried variable message sign (VMS) structures, and 80 percent indicated that they perform some level of inspection on VMS structures.

Bridge inspection teams or consultants were most likely to perform the inspections. There also was considerable demand for additional inspection guidelines.

When asked what structure type has the most problems, cantilever sign support structures were the most frequently cited (54 percent of the respondents). Specific problems that were frequently indicated include: anchor bolt construction defects, missing/loose bolts in connections, weld defects in construction, and fatigue cracking (both column-to-mast connections and anchor bolts).

Complete results can be found in our upcoming publication, *Light Pole and Sign Structure Inspection: State-of-the-Practice Survey*. This report is currently in the publication process and should be available soon.

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Procedure for the UT of Pins Nearing Completion

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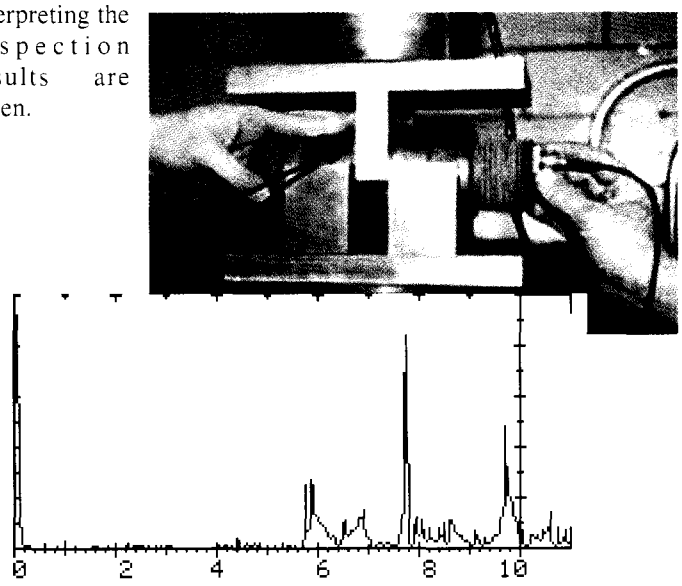
should be expected from an inspection and how to ensure that requirements are satisfied. Specific examples of data to be collected, a typical presentation of inspection results, useful equations, and strategies for interpreting the inspection results are given.



Acoustic coupling test setup and resulting A-scan

For further information, contact:

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Specialty Workshop In NDE at 2002 Annual TRB Meeting

To provide a practical introduction to the most commonly employed nondestructive evaluation (NDE) technologies and the methods used to apply them, a full-day workshop was conducted on Sunday, January 13, 2002, at the annual meeting of the Transportation Research Board (TRB) in Washington, D.C.

This workshop presented useful information to mid and upper level managers with civil engineering backgrounds. The basic physics, capabilities, and limitations of each method were discussed in an intuitive and nonmathematical manner. Typical applications were also described with a special emphasis on practical issues, such as types of defects; testing anomalies; training and experience requirements; equipment and time requirements; and general cost information. An international group of NDE experts and practitioners presented the workshop.

The program featured presentations, demonstrations, and discussions about visual inspection techniques, general wave theory, mechanical methods, electromagnetic methods, radiography, and thermal methods. In addition, an overview of current NDE research and development was an important part of the workshop.

For further information on this workshop, check the TRB Web site at www.trb.org or contact:

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